PTU Khadouri — Engineering Faculty

Fluid Mechanics and Heat Transfer — First exam — Time 50 min

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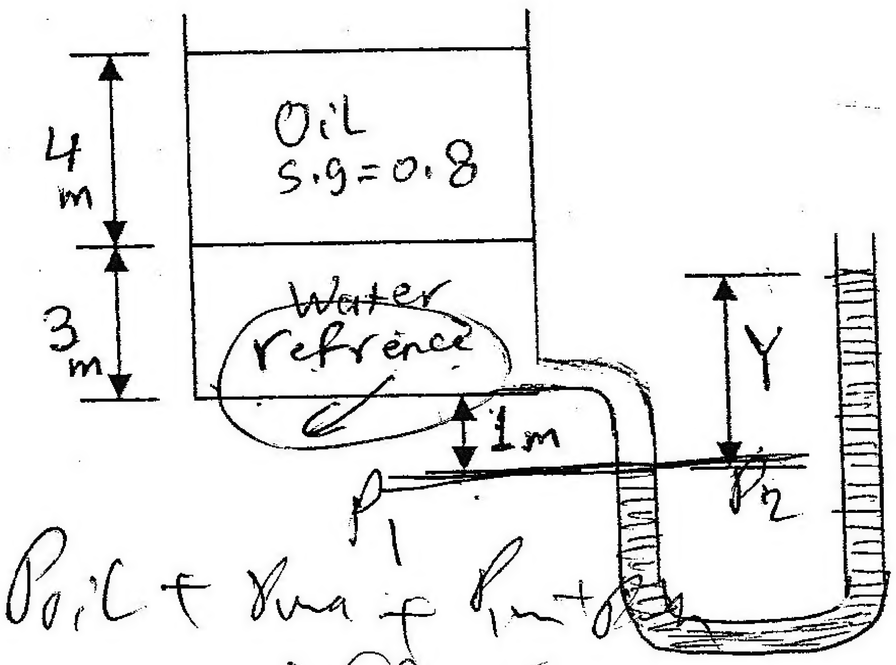
Q1 A manometer is attached to a tank containing two different fluids as shown . find the elevation of the mercury column in the manometer Y. (5 p)

$\gamma_w = 9.79\ KN/m^3$



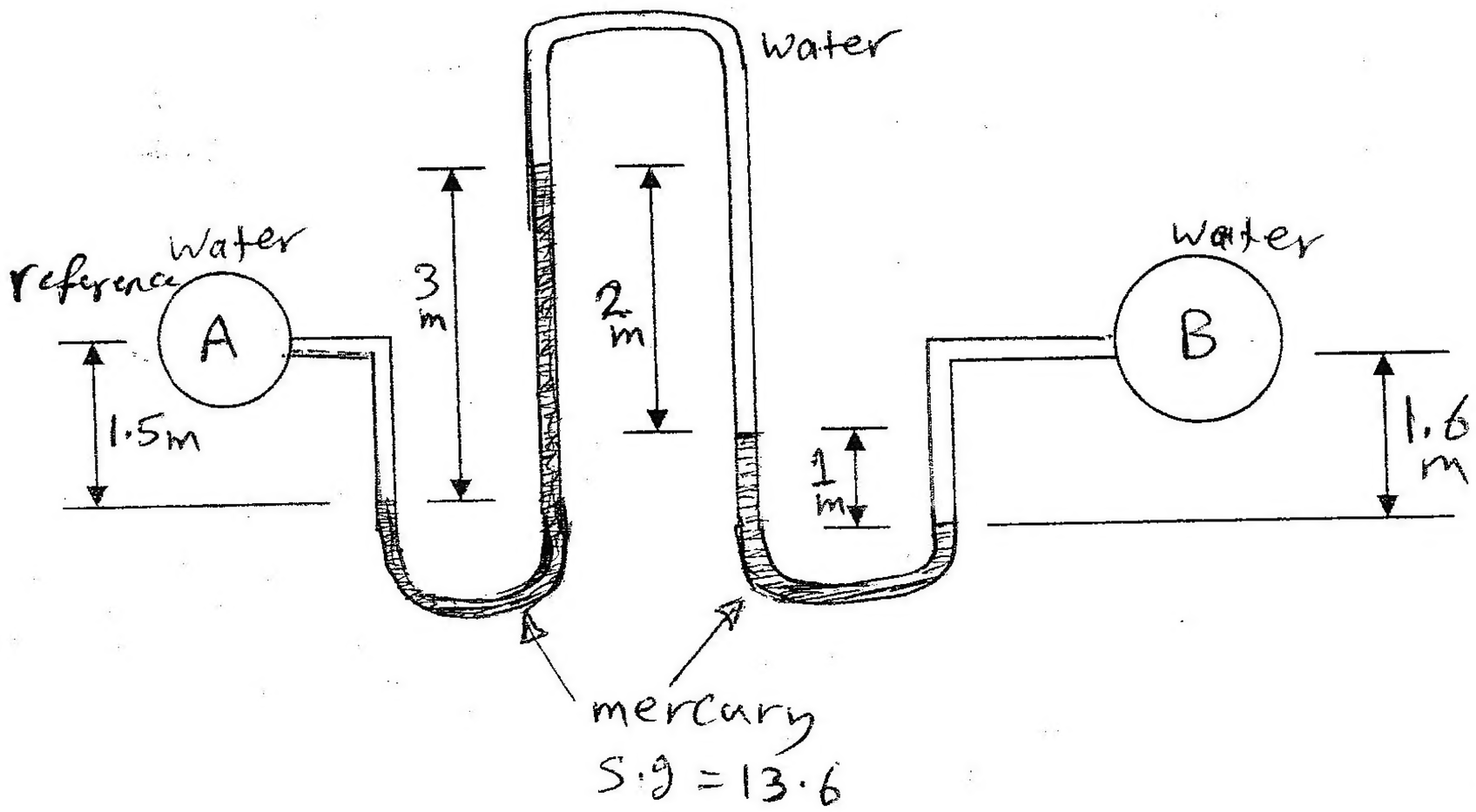
Fluid First

تم الرفع بواسطة
م. معن ابو عيسى

$P_1 = P_{oil} + \gamma_{wa} + P_{1m} + \gamma$

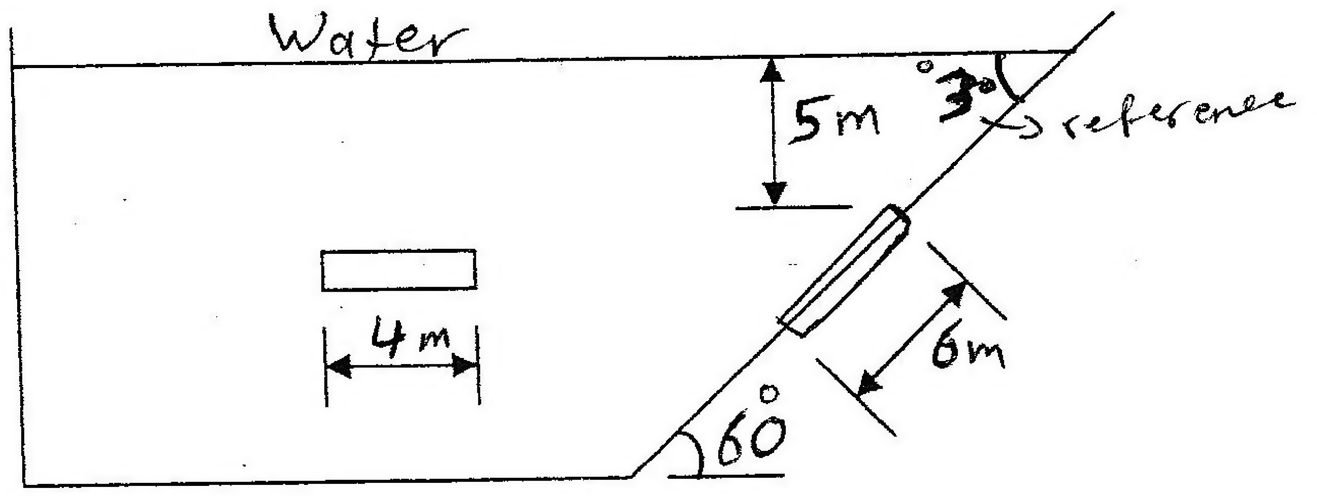
$P_1 = P_{atm} + \gamma$

Q2 Determine the pressure difference between pipes A and B for the differential manometer shown . (5 p)

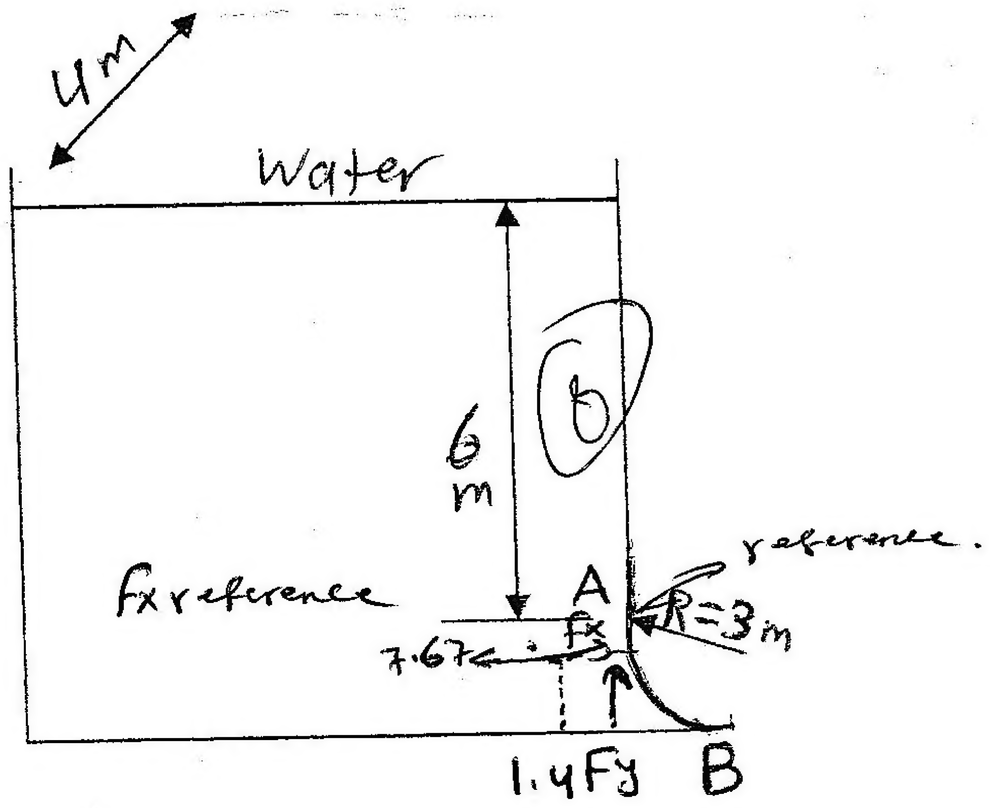


يتبع ←

Q3 An inclined rectangular gate (4m x 6m) with water on one side as shown. Find the total resultant force on the gate and locate the center of pressure. (6 p)
($I_{cg} = bh^3/12$)



Q4 The submerged curved surface AB is one quarter (1/4) of a circle of radius 3. meter. The water depth is 6meter and the tank width is 4 meters. Determine
1- horizontal and vertical components of the total resultant force acting on curved surface
2-the location of these components (9 p)
(c.g = $4r/3\pi$)



Good Luck

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العلامة 19/25

هندسة ميكانيكية

Q1 $P_{water} + P_{oil} = P_{mercury}$ $+P_{atm}$ $+P_{atm}$ حيث الضغط الجوي

$9.79 * 4 * 0.8 + 9.79 * 3 + 9.79 * 1 + 13.6 * 9.79 y = 0$

$\Rightarrow 31.328 + 29.37 + 9.79 = 133.144 y$

$\Rightarrow 70.488 = 133.144 y$

$\Rightarrow y = 0.529 m$ 3/5

Q2 reference is A

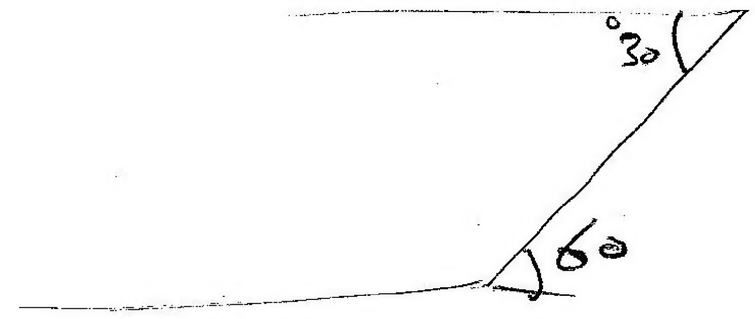
$P_A + 1.5 * 9.79 - 13.6 * 9.79 * 3 + 2 * 9.79 + 13.6 * 9.79 - 1.6 * 9.79 = P_B$

$\Rightarrow P_A + 14.685 - 399.432 + 19.58 + 133.144 - 15.664 = P_B$

$P_A + 167.409 - 415.096 = P_B$

$P_A - P_B = 247.687 kpa$ 5

3



Q3 $h_{cg} = 5 + \frac{1}{2} * 6 \sin 30 = 5 + 1.5 = 6.5$ m

$F = \gamma h A = 9.79 * 6.5 * 24 = 1527.24$ kN

$h_{cp} = h_{cg} + \frac{I_s}{h_{cg} A}$

$\Rightarrow I_s = b h^3/12 = \frac{4 * 6^3}{12} = 72$ m⁴

$h_{cp} = h_{cg} + \frac{72}{6.5 * 24}$

$= \frac{6.5}{} + \frac{72}{156} = 6.5 + 0.4615 = 6.961$ m

4/6

$h_{cp} = 6.961$ m

Q4 r = 3 m, water depth is 6 meter, width is 4

find fx, fy

2 - location of the components

$F_x = \gamma A h_{cg}$

$h_{cg} = 6 + \frac{3}{2} = 6 + 1.5 = \boxed{7.5\ m}$

projected Area 4X3

$F_x = \gamma h_{cg} A = 9.79 * 7.5 * \frac{\pi (3)^2}{4} * 4$

$= \boxed{519.01\ kN}$

$F_y = \text{volume} * \gamma$

$= \left((6 * 3 * 4) + \frac{\pi (3)^2}{4} * 4 \right) \gamma$

$= (72 + 28.274)\ 9.79$

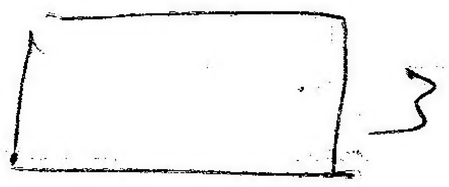
$\boxed{F_y = 981.68\ kN}$

~~h_{cp} of fx =~~

~~$h_{cp} = h_{cg} + \frac{I_s}{h_{cg} A}$~~

التعدي على ~~A~~ العبر

$$hcp = hg + \frac{Is}{hgA}$$



نعتبرها عبارة عن مستطيل ⇐ $Is = \frac{bh^3}{12} = \frac{4*3^3}{12} = 9\ m^4$

$$hcp = 7.5 + \frac{16}{7.5*12} = \boxed{7.6778\ m} \Rightarrow y\ component$$

$$\bar{X}\left(\left(6*3\right) + \left(\frac{\pi(9)}{4}\right)\right) = A_1X_1 + A_2X_2$$

$$\bar{X}\left(18 + 7.0685\right) = \left(6*3*1.5\right) + \left(\frac{\pi(9)}{4}\right)\left(\frac{4*3}{3\pi}\right)$$

$$(25.0685)X = 27 + 9$$

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$$25.0685X = 36$$

$$\Rightarrow \boxed{X = 1.4360685}$$

B تبعد عن النقطة